

NEW SPECIES OF FROGS FROM BORACÉIA, SÃO PAULO, BRAZIL

W. Ronald Heyer

Abstract. — Four new species of frogs are described from Boracéia, the University of São Paulo's field station in the Atlantic forests of Brazil: *Hyla hylax*, *Eleutherodactylus randorum*, *E. spanios*, and *Physalaemus franciscae*. In order to allocate *Eleutherodactylus* names, the status of *Eupemphix bolbodactyla*, *Basanitia gehrti*, *B. lactea*, *Hylaplesia nigriventris*, *Eleutherodactylus unistrigatus holti*, and *E. venancioi* are briefly discussed. Lectotypes are designated for *Basanitia lactea* and *Hylaplesia nigriventris*. *Eleutherodactylus holti* is recognized as a valid species from Itatiaia, Rio de Janeiro, Brazil.

A summary of our knowledge of the frogs of Boracéia is being prepared (Heyer, Rand, Cruz, Peixoto, Nelson, in prep.). In the process of identifying the frog fauna from this locality in the Atlantic forests of coastal Brazil, several species have been studied that lack names. The purpose of this paper is to describe these new species before our larger report is published. A new species of *Hylodes* is the subject of a separate report (Heyer and Cocroft, in prep.).

Species Descriptions

Carlos Alberto G. da Cruz, Oswaldo Peixoto, and I sorted out three members of the *Hyla circumdata* group from specimens collected at Boracéia: *Hyla astartea* Bokermann, 1967, *Hyla circumdata* (Cope, 1867), and a new species, to be known as

Hyla hylax, new species Fig. 1

Holotype. —MZUSP 59937, adult male from Brazil: São Paulo; Boracéia, approximately 23°38'S, 45°50'W. Collected by A. Stanley Rand, 4 Nov 1983.

Paratopotypes. —MZUSP 2357, 2535-41, 4030-31, 30875-78, 30892-94, 30901-03, 34571, 34576-77, 37801-03, 54499-501, USNM 208744, 208747, 208749, 208754, 208757, 208764-71, 208776, 208779, 208781-82, 243466-74, taken by various collectors on various dates.

Diagnosis. —*Hyla hylax* has in common a well developed prepollex and posterior face of thigh with dark vertical stripes with *Hyla astartea*, *H. carvalhoi*, *H. circumdata*, *H. izecksohni*, and *H. nanuzae*; these two characteristics distinguish this cluster of frogs from all other *Hyla* of eastern Brazil. The posterior thigh stripes are straight and bold, with some stripes connecting dorsally with stripes on the front of the thigh in *H. hylax*; the stripes are faint or discontinuous in *astartea*, *carvalhoi*, and *nanuzae*. *Hyla hylax* further differs from *astartea* and *nanuzae* in size, *hylax* having a SVL range 55-64 mm, *astartea* and *nanuzae* combined SVL ranges of 39-42 mm. *Hyla hylax* further differs from *carvalhoi*



Fig. 1. Holotype of *Hyla hylax*, dorsal view.

in that *hylax* has dark vertical stripes on the flanks, such distinct marks are absent in *carvalhoi*; *hylax* has a single, somewhat expanded vocal sac, *carvalhoi* has a bilobed subgular vocal sac. *Hyla hylax* is larger than *H. izecksohni* (SVL 34–51 mm), and the tympanum in *hylax* is noticeably smaller than in *izecksohni*. *Hyla hylax* is most similar to *H. circumdata*, from which it differs in having a moderate tympanum, its diameter just less than $\frac{1}{2}$ the diameter of the eye (tympanum large



Fig. 2. Head profiles of *Hyla hylax* (above) and *Hyla circumdata* (below). Drawings based on specimens from Boracéia.

in *circumdata*, $\frac{3}{5}$ – $\frac{3}{4}$ eye diameter) (Fig. 2), the head is narrower than long (broader than long in *circumdata*), and the male forearm is slightly hypertrophied (moderately to strongly hypertrophied in *circumdata*).

Description of holotype.—Snout shape rounded in dorsal outline, vertically rounded in profile; canthus rostralis indistinct; tympanum moderate sized, diameter about equal to $\frac{1}{2}$ diameter of eye; vomerine teeth in arched series, contiguous medially, arching posteriorly, between choanae anteriorly, extending behind posterior edges of choanae posteriorly; vocal slits present; vocal sac single, barely expanded externally; finger disks large, disk on finger III equal to tympanum; finger web formula I trace II 2^- – 3^+ III $2\frac{1}{2}$ – 2^+ IV; subarticular tubercles prominent, rounded, single; very faint brown nuptial pad between base of thumb and prepollex; forearm noticeably hypertrophied but not extensively so; prepollex well developed, spines not exposed; distinct tuberculate ulnar ridge; short, distinct supratympanic fold, weak glandular transverse fold above anus; dorsal texture smooth; throat smooth; belly areolate; toe disks moderately large, slightly smaller than finger disks; toe web formula I $1\frac{1}{2}$ –2 II $1\frac{1}{4}$ – $2\frac{1}{4}$ III 1^+ – $2\frac{1}{2}$ IV 2^+ – 1^+ V; inner metatarsal tubercle large, ovoid; outer metatarsal tubercle small, indistinct, rounded; distinct inner tarsal fold extending length of tarsus; moderately large calcar on left heel, small calcar on right.

Color in preservative: Face almost uniform brown with darker brown washes, no distinct pattern; top of head light brown with darker brown anastomosing stripes; dorsum of body light brown with darker brown transverse cross bars; upper limbs also brown with dark brown cross bands; anterior flanks with incomplete vertical stripes, mid- and posterior flanks light cream and scattered brown dots (same as dorsal ground color) with distinct dark vertical stripes, light areas 2–4 times width of stripes; posterior face of thigh brown with distinct black vertical stripes, lighter areas 1–2 times width of stripes, about every other stripe continuous dorsally with stripes on front surface of thigh; throat cream and profused with brown melanophores; belly cream with a few scattered brown melanophores.

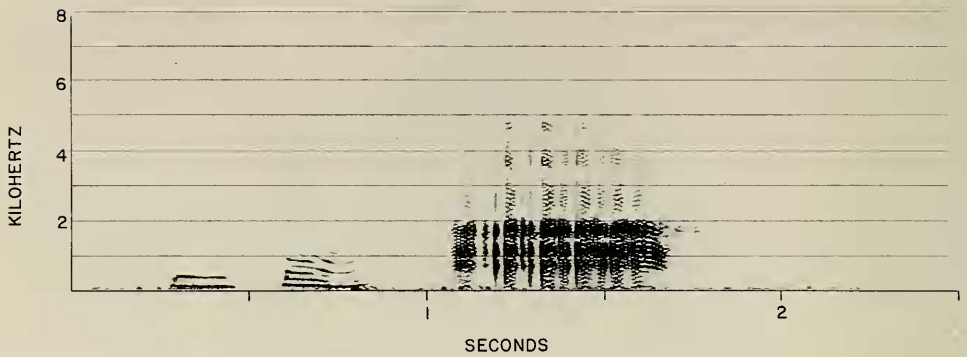


Fig. 3. Advertisement call of *Hyla hylax*. Recorded from holotype, 2011 h, 4 Nov 1983, 17.5°C air temperature.

Measurements in mm: SVL 58.5, head length 20.8, head width 20.4, femur 28.3, tibia 29.8, foot 25.1.

Variation.—Males range from 55–62 mm SVL. The two females available measure 60.0 and 63.4 mm, respectively. The larger female has an obviously more flared and broader head. Other than this female, there is relatively little variation in most morphological features including extent of digital webbing. The dorsal pattern ranges from uniform to a crossbar pattern. A mid-dorsal dark stripe extending from the tip of the snout to at least the scapular region is present in some individuals. Some individuals have bold dark outlined enamel cream spots on the elbows, the heel calcars and the anal fold. There may be slight to distinct demarcation of dorsal and ventral color along the ulnar fold and a light tan stripe on the outside edge of the foot and tarsus may extend to the calcar. The dark stripes on the flanks may equal the width of the light areas, or be only $\frac{1}{3}$ – $\frac{1}{4}$ as broad as the light areas. In some individuals every other flank stripe is continuous with a dorsal cross band. The stripes on the posterior face of the thigh may be closely packed, such that the space between stripes is about equal to the stripe width, or spread out, such that the lighter areas between stripes are 2–3 times the stripe width.

Color in life: (From Rand and Rand notes on specimen MZUSP 30904) “Dirty tan with brown middorsal stripe from snout, fading out at vent. Few small cream blotches lower back. Legs and arms same color as back, banded with wide orange tan except for femur which has very narrow tan band above and is flesh colored on front and back with dark grey bands. This continues onto concealed surface of tibia. Sides yellow gold, deeper at groin with pale transverse banding. Chin and throat cream with tiny black flecks. Belly and under femur anteriorly pale orange cream. Under femur behind this dirty tan. Under arms, hands, behind shoulder and under legs flesh color.”

Advertisement call.—(Description based on calls from several specimens.) Call duration about 0.5–1.0 s; calls given sporadically; calls pulsed, pulses grouped together forming notes within call initially, more continuous but still not even pulse rate at end of call; pulse rate about 100 per s; calls not noticeably frequency modulated; call intensity moderately modulated, first half of call loudest; domi-

nant frequency range 400–2300 Hz; no apparent harmonic structure; distinct sidebands due to pulsatile nature of call (Fig. 3).

Etymology. —Latinized Greek for barker, in allusion to the distinctive dog bark-like advertisement call.

Referred specimens. —Brazil: Paraná; Práinha, MZUSP 36002; São Paulo; Boracéia; MZUSP 34578–80, 34588–91, 34599–601, 34603–04, 37795 (juveniles); São Paulo; Ferraz de Vasconcelos, MZUSP 34474; São Paulo; Paranapiacaba, MZUSP 8870, 9629, 10621–23, 10978, 13873–76.

There are four species of *Eleutherodactylus* from Boracéia to which names are readily applied: *E. binotatus*, *guentheri*, *hoehnei*, and *parvus*. In addition, there are other *Eleutherodactylus* specimens that are small in size as adults and their variation is considerable and difficult to interpret. Conservatively, these additional specimens represent a minimum of two species and possibly as many as six. I think at least four species are represented, one of which is represented only by a single juvenile specimen. For this specimen (USNM 243675), description is deferred until an adult is obtained. These small *Eleutherodactylus* all belong to the section of the genus that has at times been recognized as a distinct genus of its own, *Basanitia*. Several names have been proposed for members of this group; examination of the original descriptions, topotypic material, and most of the types indicates that only one name applies to the species from Boracéia. The names that could be or have been applied to the Boracéia frogs are *Eupemphix bolbodactyla*, *Basanitia gehrti*, *B. lactea*, *Hylaplesia nigriventris*, *Eleutherodactylus unistrigatus holti*, and *E. venancioi*. Each of these names is briefly discussed.

Eupemphix bolbodactyla A. Lutz, 1925.—Two cotypes, USNM 96542–43, are in very poor condition, owing in part from incisions made through the angle of the jaw and body wall almost to the groin. Several digit tips are missing in both specimens. USNM 96542, an approximately 16 mm SVL male with vocal slits, has the snout region destroyed. USNM 96543, a 14.5 mm specimen, shares with 96542 the following character states: disks not greatly expanded, vomerine teeth present, and pattern completely non-existent (due to fading, as Lutz described a color pattern for this species in the original description). The disks are small relative to the Boracéia species, indicating that the name *bolbodactyla* does not apply to any of the Boracéia species. Further clarification of *bolbodactyla* will depend on examination of well preserved topotypic material and the MNRio cotype. Designation of a lectotype at this time is premature.

Basanitia gehrti Miranda-Ribeiro, 1926.—The holotype and only known specimen of *B. gehrti* could not be located at either MNRio or MZUSP in May 1984. The MZUSP collection has been reorganized recently and it is unlikely that the type was missed but it is possible that it was missed during the search of the MNRio collection. Miranda-Ribeiro's description is brief. The characters that pertain to association with the Boracéia species are: tympanum small, barely evident; vomerine teeth present; three outer fingers with very large disks, the first without a disk; skin smooth; dorsum uniform black with a white cephalic-coccygeal line, under sides of disks, belly, and thighs, lighter. This combination of characteristics does not match any of the species from Boracéia; the most similar is the juvenile specimen USNM 243675. Bokermann (1966a:15) placed *gehrti*, from Alto da Serra, São Paulo, in the synonymy of *Basanitia nigriventris*, another

species described in part from the same locality. The dorsal texture of *nigriventris* is tuberculate, but preservation differences could account for *gehrti* having been described as having a smooth skin. The identity of *gehrti* will not be resolved satisfactorily until the type specimen is located and examined. Nevertheless, the characters that Miranda-Ribeiro used to describe the animal differentiate it from the Boracéia species, with the exception of the above mentioned juvenile. Until evidence to the contrary is presented, I believe it best to allow *gehrti* to remain in the synonymy of *nigriventris*.

Basanitia lactea Miranda-Ribeiro, 1923.—Miranda-Ribeiro described *lactea* on the basis of two specimens, a 32 mm specimen from Iguape, São Paulo (MZUSP 828), and a 19 mm individual from Campo Grande (MZUSP 504). MZUSP 828 is the specimen described and figured by Miranda-Ribeiro. MZUSP 504, the second syntype, is an adult female *Eleutherodactylus parvus*. MZUSP 828 is hereby selected as the lectotype of *Basanitia lactea* Miranda-Ribeiro. The lectotype is no longer in good condition—most of the finger disks have disintegrated and the feet are torn apart. A very faint pattern still persists, consistent with the pattern shown in Miranda-Ribeiro's illustration. The back of the thigh in particular is boldly mottled, and the front of the thigh has a faint suggestion that it, too, was boldly mottled. The tympanum is hidden, the dorsum is smooth, and there is no indication that the belly was ever dark. The specimen is an adult female with the following measurements: SVL 32.2 mm, head length 11.7 mm, head width 11.3 mm, femur 15.1 mm, tibia 14.9 mm, and foot approximately 14.5 mm. The size and pattern distinguish *lactea* from the species at Boracéia.

Hylaplesia nigriventris A. Lutz, 1925.—Lutz described *nigriventris* on the basis of more than one specimen (number not specified) from Itatiaia and Serra de Cubatão. Bokermann (1966a:65) stated that in the Adolpho Lutz collection he found two specimens (720, 721) labelled as types from Paranapiacaba (=Serra de Cubatão). Professor Antenor Leitão de Carvalho kindly located three specimens indicated as types for my examination: 719, 720, 721. All three specimens have the same locality data of Alto da Serra de Cubatão [=Paranapiacaba]. There is an additional cotype, USNM 96846, from the same locality. Thus, the Itatiaia specimen or specimens are probably lost. Based on zoogeography, it would not be surprising if the Itatiaia and Paranapiacaba specimens were different. The 21 mm SVL specimen Lutz described is apparently lost and may have been from Itatiaia. The remaining types are 17.8 mm SVL (AL 719), 8.2 mm (AL 720), 7.0 mm (AL 721) and 6.5 mm (USNM 96846). AL 720 is a juvenile *Eleutherodactylus guentheri*. The other three specimens appear to be conspecific and are used for application of the name *nigriventris*. The specimens are almost black, a coloration presumably artificially caused as the insides of the mouths are also black. As AL 719 is the largest specimen and easiest to compare with other specimens, it is hereby designated as the lectotype of *Hylaplesia nigriventris* A. Lutz. The lectotype has a series of warty tubercles on the dorsum and upper eyelid; a particularly prominent calcar, an indistinct tympanum, very large disks on the outer fingers and toes, and even though the bones have become decalcified, vomerine teeth are visible. As indicated above, the lectotype is dark and shows no indications of pattern. The lectotype shares all diagnostic character states with a 19.0 mm SVL male from Boracéia, MZUSP 37787; the two specimens are considered conspecific. The color pattern in preservative of MZUSP 37787 is: face with a dark brown

mark in canthal region just behind nostril, rest of face brown with indistinct darker brown oblique bars below eye, dark supratympanic spot; dorsum a complex pattern of lighter and darker browns with large brown blocks; upper limbs brown with darker brown cross bands; anterior flank a meeting of dorsal and ventral patterns, in groin area a bold dark brown and cream mottle extending onto anterior surface of thigh; posterior surface of thigh with a light ovate cream area in mid-thigh to knee surrounded by more or less uniform brown, light area extending a bit more medially as a broken pattern; hidden and under surfaces of tibia with bold dark brown and cream mottle; throat uniform dark brown with very small, scattered light punctations; belly dark brown with light dots.

Eleutherodactylus unistrigatus holti Cochran, 1948.—The holotype, from “Alto Itatiaia,” matches quite well with recently collected specimens of *Eleutherodactylus* from Brejo da Lapa, Itatiaia. At Brejo da Lapa, only one species of *Eleutherodactylus* has been collected. The species is common, however. The holotype matches recent specimens in: (A) body proportions, including relatively long fingers with large truncated, dorsally notched disks on fingers III and IV; (B) small vomerine tooth patches; (C) tympanum indistinct but externally visible; (D) areolate belly; (E) small calcar; (F) 2–3 distinct darkish tubercles on sole of foot. The holotype is in poor condition, and the pattern is no longer discernible. The figures Cochran drew showed some pattern details, which are matched in the recent specimens. The holotype is a male with vocal slits. Cochran gave the SVL as 19 mm; I measure no more than 17 mm, but the specimen is compacted.

There are proportional differences between the Itatiaia form and *E. unistrigatus*, most strikingly in head shape and finger lengths. The structure of the finger and toe disks is very different—*unistrigatus* with truncate or ovately truncate disks lacking a dorsal indentation; the Brejo da Lapa form has large, dorsally indented disks. The differences are of a magnitude more consistent with species level differentiation and are so considered.

With the name *nigriventris* restricted to the lectotype from Paranapiacaba, *Eleutherodactylus holti* is the available name for the species from the higher elevations of Itatiaia. *Eleutherodactylus holti* and *nigriventris* are distinct species, differing in body shape, degree of dorsal wartiness, and particularly in calcar size. The calcar of *nigriventris* is large and prominent; the calcar of *holti* is small and indistinct, if expressed.

Eleutherodactylus venancioi B. Lutz, 1959.—Recently collected topotypes agree well with Lutz’s description and illustration. This large disked species differs from all Boracéia large disked species in having a combination of a long slender snout, a distinct face mask, and small size, males about 17 mm and females 24 mm SVL.

There remain three species of *Eleutherodactylus* from Boracéia lacking names. As indicated above, description of a juvenile specimen (USNM 243675) is deferred until associated adults are collected. The two species described below differ from all other *Eleutherodactylus* from coastal Brazil except *holti*, *lactea*, *nigriventris*, *parvus*, *pusillus*, and *venancioi* in having a hidden or indistinct tympanum in contrast to a distinct, exposed tympanum with the annulus obvious externally at least on the sides and ventrally (also see Heyer 1984, Table 19). Of these, *parvus* and *pusillus* have small, pointed finger disks in contrast to the large triangularly ovate disks on the outer fingers of *holti*, *lactea*, *nigriventris*, *venancioi*, and the

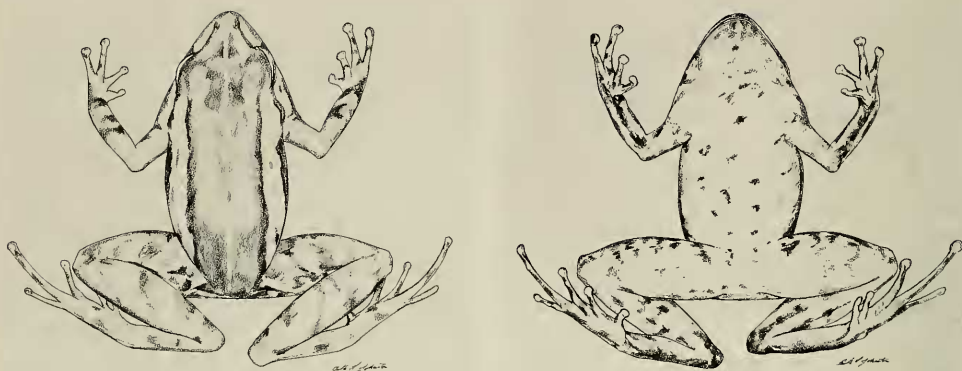


Fig. 4. Holotype of *Eleutherodactylus randorum*, dorsal and ventral views.

new species. For comparative purposes, the new species are diagnosed only between themselves and *holti*, *lactea*, *nigriventris*, and *venancioi*.

Eleutherodactylus randorum, new species

Fig. 4

Holotype.—MZUSP 59936, an adult male from Brazil; São Paulo; Boracéia, approximately 23°38'S, 45°50'W. Collected by W. Ronald Heyer on 2 Nov 1983.

Paratopotypes.—MZUSP 23665–70, 23672–74, 23676–77, 34635, 36865, 37555, 49644, USNM 243475–78, 244635.

Referred specimen.—MZUSP 23675, a slightly morphologically distinct specimen from Boracéia.

Diagnosis.—*Eleutherodactylus randorum* differs from *holti*, *lactea*, *nigriventris*, *spanios*, and *venancioi* in lacking vomerine teeth; vomerine teeth are either visible or can be felt by probe in the other species.

Description of holotype.—Snout shape subovoid in dorsal outline, rounded-protruding in profile; canthus rostralis indistinct; tympanum hidden; no vomerine teeth; vocal slits present; vocal sac large, single, externally expanded from mid-throat to just past posterior level of arm insertion; thumb lacking disk, large disk on finger II, very large disks on fingers III and IV, disks ovately triangular, upper surfaces medially indented; fingers free of web; subarticular tubercles indistinct; no nuptial asperities or other secondary sexual characteristics; no prepollex; no ulnar ridge; no distinctive body glands or folds; dorsum smooth except for few low tubercles on upper eyelid; throat smooth; belly weakly granular; toe disks large, but smaller than largest finger disks; toes free of web; inner metatarsal tubercle oval, outer small and round; no tarsal fold or tubercle; heel with single modest tubercle.

Color in preservative: Dark canthal stripe, dark outlined forwardly directed oblique bar under eye on upper lip, dark stripe from posterior corner of eye continuous with flank stripe; dorsum more or less uniform tan mid-dorsally with broad light dorsolateral stripes, light incomplete mid-dorsal pin stripe, light broad

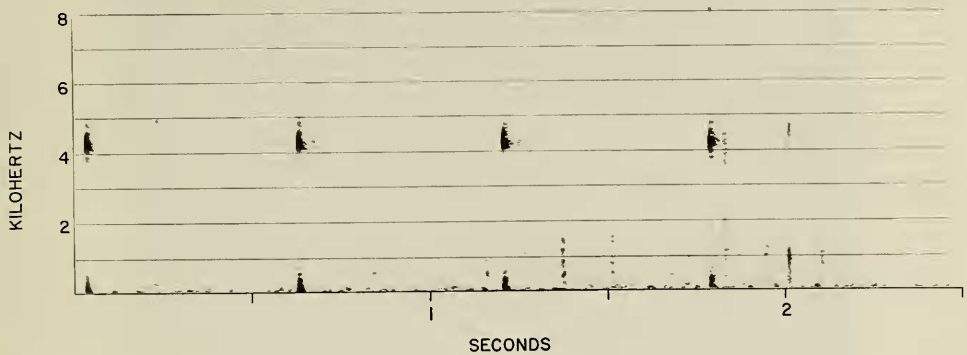


Fig. 5. Advertisement call of *Eleutherodactylus randorum*. Recorded from holotype, 2045 h, 2 Nov 1983, about 19°C air temperature.

dorsolateral stripe bordered above and below with dark brown stripe; upper limbs indistinctly cross banded; flanks with continuation of broad light dorsolateral stripe to groin; posterior surface of thigh mottled, faint dark seat patch, light transverse stripe under anus; more or less uniformly scattered melanophores on throat and belly, superimposed with scattered dark speckles.

Measurements in mm: SVL 14.8, head length 5.9, head width 5.1, femur 6.9, tibia 7.3, foot 6.5.

Variation.—There is considerable morphological and pattern variation among the specimens at hand. The upper eyelid varies from smooth to having several distinct tubercles. The tympanum is either hidden or indistinct, when indistinct of moderate size, about $\frac{1}{2}$ diameter of eye. The male vocal sac begins either from under the nostril level or from a level under the posterior edge of the eye; the smallest male (11.8 mm) does not have an expanded sac. The dorsum is smooth to scattered with tubercles. The outer metatarsal tubercle is indistinct in some individuals. The heel tubercle ranges from indistinct to very distinct. The mid-dorsal area ranges from almost uniform brown or tan to mottled. Mid-dorsal and dorsolateral stripes are present or absent. The referred specimen, MZUSP 23675, has a broad light mid-dorsal area bordered laterally with dark pin stripes. The face pattern is either boldly demarcated or fuzzily so, but there is still a discernible pattern of dark oblique bars under the eye, except in referred specimen MZUSP 23675, which has a more or less uniform face pattern. One specimen has a light snout. In individuals lacking broad dorsolateral stripes, the posterior flank has a bold or subtle dark and light mottled pattern in the groin or a light uniform groin pattern. Referred specimen MZUSP 23675 has an almost uniform brown throat and chest and the belly is mottled but not quite distinctly speckled. The anterior and posterior surfaces of the thigh range from almost uniformly light to boldly mottled. The seat patch ranges from indistinct to noticeable. Males range from 11.8–15.0 mm SVL, females 15.0–18.2 mm.

Color in life: (Based on composite color notes of W. R. Heyer and A. S. Rand for several individuals.) Iris with transverse brown stripe, above which lemon yellow, below which duller yellow; dorsolateral stripes cream; light areas under



Fig. 6. Holotype of *Eleutherodactylus spanios*, dorsal view.

eye cream; 2 light brown bars under eye; dorsum olive drab, pin stripes yellowish; venter dirty white with black markings; posterior surface of thigh mottled dirty white and brown/black.

Life colors vary considerably. The dorsum ranges from light brown, orange-tan, red-brown, to deep rust. The groin is black and white, brass yellow, bright yellow, or orange. The tops of the legs are brown, orange-tan, or greenish-yellow. The belly is pale, white, cream, pearl, or bronze with dark brown or black markings.

The anterior and posterior surfaces of the thighs are black and indistinct white, bright yellow, or faint orange.

Advertisement call.—(Description based on several calls from one individual.) Call consisting of 3–8 notes and of about 2–5 s duration, intercall interval 4–8 s when actively calling; note duration 0.04–0.10 s; note rate about 2 per s; notes strongly partially pulsed, each note with 3–8 discernible pulses; note pulsatile rate about 280 per s; calls not noticeably frequency or intensity modulated; dominant frequency range 3800–5200 Hz; no apparent harmonics (Fig. 5).

Etymology.—Named for Patricia and Stanley Rand, who through their field efforts added appreciably to our knowledge of the natural history of the frogs from Boracéia.

Eleutherodactylus spanios, new species

Fig. 6

Holotype.—MZUSP 23664, an adult male from Brazil; São Paulo; Boracéia, approximately 23°38'S, 45°50'W. Collected by Patricia and Stanley Rand, 13 Feb 1963.

Paratopotype.—MZUSP 23671.

Diagnosis.—*Eleutherodactylus spanios* is a small species, the known male 14.7 mm SVL and the known female 21.4 mm SVL; the known males and females of *holti*, *lactea*, *nigriventris*, and *venancioi* exceed 16 and 24 mm respectively. *Eleutherodactylus spanios* is most similar to *E. randorum*, from which it differs by having vomerine teeth and a non-expanded vocal sac in the males.

Description of holotype.—Snout shape subovoid in dorsal outline, rounded in profile; canthus rostralis indistinct; tympanum indistinct, about ½ eye diameter; vomerine teeth discernible by probe, not visible under low magnification, posterior and medial to choanae; vocal slits present; vocal sac single, not expanded; tip of thumb swollen, disk on finger II moderately large, disks on fingers III and IV large, just smaller than tympanum, ovately triangular, slightly medially indented dorsally; fingers free of web; subarticular tubercles indistinct; no nuptial asperities or other secondary sexual characteristics; no prepollex; no ulnar ridge or fold; dorsum smooth; throat and belly smooth; toe disks large, just smaller than finger disks; toes free of web; inner metatarsal tubercle oval, outer small, round, distinct; no tarsal fold or tubercle, tarsus smooth; heel with moderate sized tubercle.

Color in life: (Edited from Rand and Rand field notes.): Brown with lighter patterning and dark brown or black under eye, behind tympanum, over shoulders, at vent and heels; bright orange-red on concealed surfaces of legs and arms extending up onto belly where edges of red area blotchy; fingers and toes red; darker and lighter brown banding on legs and arms.

Color in preservative: Face with indistinct canthal stripe; indistinct, forwardly directed oblique bar under eye to upper lip; dark tympanic spot; dorsum with indistinct pattern of darker and lighter brown; limbs indistinctly cross banded; posterior flank light, patternless; posterior surface of thigh very light, not much pattern except for dark seat patch; throat almost uniform brown; belly mottled brown anteriorly, mostly plain posteriorly, not dark speckled.

Measurements in mm: SVL 14.7, head length 5.9, head width 4.9, femur 6.5, tibia 7.6, foot 6.5.

Variation. — The single, brittle female, 21.4 mm SVL, has one broken hind leg. The vomerine teeth are visible under low magnification. The tympanum is hidden. The belly is weakly granular. The groin is not much distinguished from the dorsal pattern. The posterior surface of the thigh is mottled, but with a lighter area toward the knee and the front of the thigh is patternless.

Advertisement call. — Unknown.

Etymology. — From the Greek *spanios*, rare, in allusion to its rarity of collection.

Comparisons. — This species is most similar to *randorum*. It differs in having vomerine teeth (absent in *randorum*), somewhat larger size, male with non-expanded vocal sac (greatly expanded in *randorum*), non-speckled belly (speckled in *randorum*), and bright orange-red flash colors (no flash colors or yellow or dull orange in *randorum*). The combined differences are interpreted to mean species level differentiation rather than intraspecific variation.

Four species of *Physalaemus* occur at Boracéia: *cuvieri*, *maculiventris*, *olfersi*, and a species that has been identified in collections and referred to in the literature as *signiferus*. The type locality of *Rhinoderma signifera* Girard, 1853, is Rio de Janeiro, Brazil. Comparison of topotypic specimens and calls of *signiferus* with the Boracéia specimens and calls indicates that the two are not conspecific.

Physalaemus franciscae, new species

Fig. 7

Holotype. — MZUSP 59935, an adult male from Brazil; São Paulo; Boracéia, approximately 23°38'S, 45°50'W. Collected by W. Ronald Heyer, 8 Dec 1976.

Paratopotypes. — MZUSP 3947, 4084, 4114, 25831, 25853, 25856, 25857–70, 25872–82, 26036–37, 37565–68, USNM 243507–45, 244636, taken by various collectors on various dates.

Diagnosis. — Lynch (1970) delineated species-groups of *Physalaemus*, and he thought that all but the *signiferus* group were monophyletic. Members of the *signiferus* group were thought to be heterogeneous, but collectively could be differentially diagnosed from other *Physalaemus* by the following combination of characteristics: small to moderate size; slender build; smooth skin; finger I shorter than II; no inner tarsal tubercle; small, non-compressed metatarsal tubercles; small to large inguinal glands; lacking parotoid glands. The members of this group, which are diagnosed from *franciscae*, are *maculiventris* (A. Lutz, 1925), *nanus* (Boulenger, 1888), *obtectus* Bokermann, 1966, *olfersi* (Lichtenstein and Martens, 1856), and *signiferus* (Girard, 1853).

Physalaemus franciscae lacks the light stripe from eye to arm insertion ventrally bordering the dark flank stripe of *olfersi*, and is smaller than *olfersi* (adult *franciscae* no larger than 29 mm SVL, adult *olfersi* 30–35 mm SVL). *Physalaemus franciscae* has a few scattered light tubercles on the sole of the foot; the sole of the foot is smooth in *maculiventris* and *nanus*. The posterior belly is boldly mottled in *franciscae*, the posterior belly lacks pattern in *obtectus* and *signiferus*.

Description of holotype. — Dorsal outline of canthus rostralis and tip of snout pointed, of upper lip rounded; snout acutely rounded in profile; canthus rostralis sharp; tympanum indistinct, almost hidden, just less than ½ eye diameter; maxillary teeth not visible, but discernible by probe; vomerine teeth absent; vocal

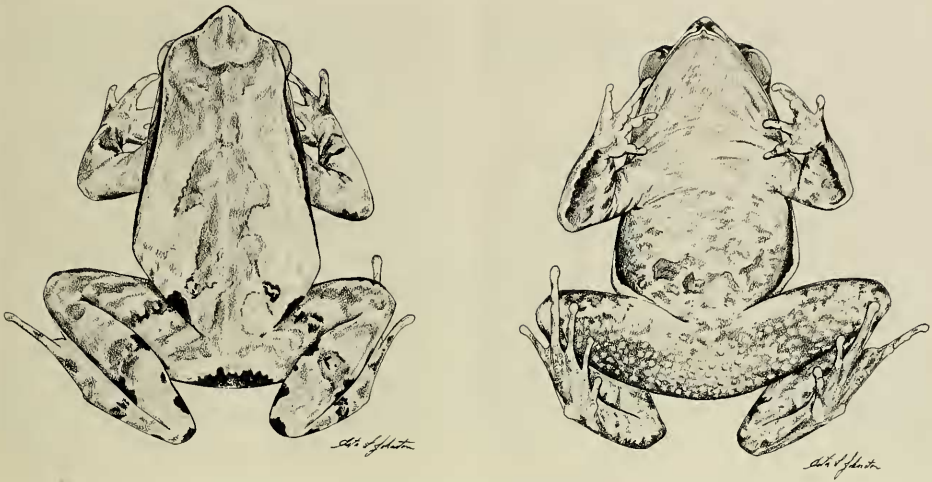


Fig. 7. Holotype of *Physalaemus franciscaae*, dorsal and ventral views.

slits present; vocal sac single, slightly expanded externally, extending to border of chest with belly; finger tips barely swollen, not disked; fingers free, lacking fringe, ridge, or web; subarticular tubercles moderately large, rounded, not pungent; pair of brown nuptial pads on each thumb, narrowly separated from each other, ovoid pad at base of thumb associated with inner metacarpal tubercle, elongate pad covering rest of upper and inner thumb surface; no prepollex; no ulnar ridge; weak supratympanic fold; dorsolateral fold from eye to groin along demarcation of dorsal and flank color, large tear-shaped lumbar gland in groin, narrow portion directed anteriorly; dorsum smooth with scattered low glandular warts, tubercles warty, tubercles most noticeable on upper eyelids, throat and belly smooth; toe tips very slightly swollen, not disked; toes free, lacking web, sides of toes weakly ridged (left fourth toe missing); inner and outer metatarsal tubercles ovoid, outer about $\frac{3}{4}$ size of inner, outer slightly compressed; short, weak tarsal fold on distal $\frac{2}{5}$ of tarsus, approaching but not contacting inner metatarsal tubercle, rest of tarsus smooth; left heel smooth, right heel with low glandular tubercle; foot smooth with few smallish light fleshy tubercles.

Color in preservative: Black canthal stripe extending to upper lip sharply delineated from dorsal color above, indistinctly set off from loreal pattern below, loreal region gray, upper lip cream with dark bars; dorsal ground color cream-tan on which a somewhat darker, continuous, almost symmetrical pattern consisting of an interorbital bar, a broad forwardly pointing arrowhead just past the shoulder region and another broken triangular pattern in the sacral region with the bases of the triangles extending to and joining the black groin spots, all outlined with cream pin stripes, faint indications of other darker markings paralleling the triangular marks; forelimb with a dark cross band, rest of upper surfaces of arms mottled light brown-tan; when leg folded, a single dark cross band continuous across femur, adjacent tibia and adjacent tarsus, rest of upper leg surfaces indistinctly mottled tan and brown; forearm with sharply demarcated line separating light dorsal and dark ventral pattern; inner and outer surfaces of tibia tan with

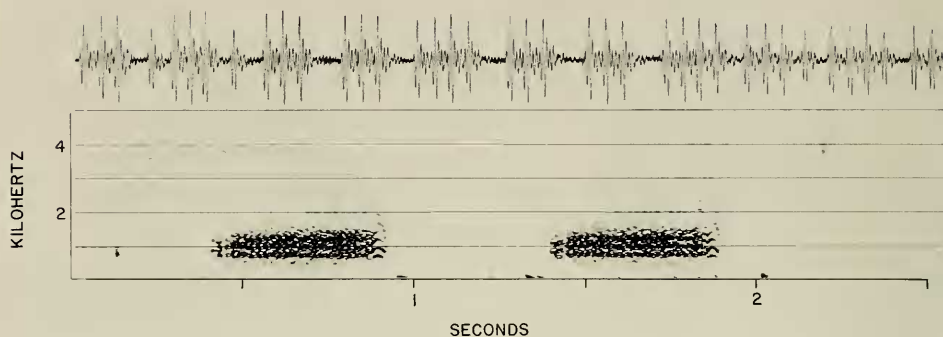


Fig. 8. Advertisement call of *Physalaemus franciscaae*. Wave form signal length 0.214 s showing portion of call on left of audiospectrogram. Recorded from holotype, 8 Dec 1976, 21.5°C air temperature.

bold black spots; black flank stripe sharply demarcated from dorsal color above from posterior edge of eye to lower groin, not quite extending to femur, dark flank stripe fading into ventral color rather than being sharply defined from it; very distinct white outlined black spot in groin on lumbar gland, spot about $\frac{1}{3}$ size of gland; dark seat patch bordered by filigree pattern; light dorsal pattern extending deeply onto posterior surface of thigh, lower distal portion of posterior surface of thigh with darker mottle, lower mid-portion with 1–2 distinct dark blotchy spots; throat dark gray-brown mottle extending onto chest; belly with bold dark gray and cream mottle, especially on posterior $\frac{1}{2}$ of belly.

Measurements in mm: SVL 25.4, head length 8.5, head width 8.8, femur 11.5, tibia 11.9, foot 11.9.

Variation.—The tympanum ranges from hidden to almost distinct. The male vocal sac is either expanded from the tip of the chin through the chest or not expanded externally. The first finger is about the same length as the second, but may be either just shorter or just longer than second. The outer metatarsal tubercle ranges from about $\frac{1}{3}$ to almost as large as the inner. The short tarsal fold contacts the inner metatarsal tubercle in a few specimens; the fold is usually distinct but sometimes indistinct. There is relatively little variation in color patterns, mostly involving intensity of patterns. The males range from 25.0–27.0 mm, females 24.8–28.2 mm.

Color in life: (From USNM 243520.) Iris bronze; throat with salmon cast; belly cream and black with brown cast; groin with salmon cast. (Rand and Rand color notes from MZUSP 25863–65.) Light khaki with patterning on back, edged with dark. Dark spots at end of belly and on tibia. Back of thighs and heels dark brown. Orange on groin. Belly and legs speckled.

Advertisement call.—Call duration 0.50–0.70 s; calls given frequently when calling; call of complex structure including harmonics and pulses, beginning and most of call with 22–28 pulses, call ending with short non-pulsed portion, pulse rate about 50 per s; calls with slight but noticeable frequency modulation (warble) throughout call; calls quiet, starting and ending with lower intensity; dominant frequency range 600–1600 Hz; several distinct harmonics (sidebands?) at a fundamental frequency of about 250 Hz (Fig. 8).

Etymology.—Named in honor of Francisca Carolina do Val, who for the last several years has been the administrator of Boracéia and has greatly facilitated research at the field station.

Referred specimens.—Brazil: São Paulo; Casa Grande, MZUSP 37327; São Paulo; Paranapiacaba, MZUSP 6477, 8851.

Comparisons.—*Physalaemus franciscae* is most similar to *P. obtectus* and *P. signiferus*. In addition to the belly pattern differences given in the diagnosis, the calls of the three differ from each other in terms of length and pulse structure. The call of *P. obtectus* is composed of 3 or 4 notes, each note comparable to the entire call of *franciscae* and *signiferus*, with a note duration of about 0.08 s. The calls of *signiferus* are longer in duration, about 0.30 s, and the calls of *franciscae* longest, about 0.60 s. Further, only the final portion of the call of *P. franciscae* is non-pulsed, whereas the entire calls of *obtectus* and *signiferus* seem to lack the pulsation of *franciscae*. The entire call of *signiferus* appears very similar to the final portion of the call of *franciscae*. (Comparative data for *P. obtectus* and *signiferus* from Bokermann 1966b.)

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Department of Vertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560, U.S.A.